

WHAT IS CLAIMED IS:

1. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching power supply, the switching power supply controller comprising:

a high-pass filter for cutting off a low-frequency component included in a signal corresponding to a duty ratio of the drive signal;

integrating means for integrating a signal resulting from the cutoff of the low-frequency component by the high-pass filter;

difference calculating means for calculating a difference between a signal indicating a difference between an output voltage of the switching power supply and a target voltage for the output voltage, and a signal resulting from the integration by the integrating means; and

drive signal generating means for generating the drive signal, based on a signal resulting from the calculation by the difference calculating means, and a ramp signal.

2. The switching power supply controller according to Claim 1, wherein the high-pass filter is a second-order high-pass filter.

3. The switching power supply controller

according to Claim 1, further comprising counter means for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

5 wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a value resulting from the counting by the counter means.

4. The switching power supply controller according to Claim 1, further comprising delay means
10 for retaining the signal resulting from the calculation by the difference calculating means, for a predetermined time and then outputting the signal,

 wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by
15 the delay means.

5. The switching power supply controller according to Claim 4, wherein the drive signal generating means switches a level of the drive signal from a low level to a high level at a predetermined
20 interval and switches the level of the drive signal from the high level to the low level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal, and

25 wherein, based on the signal resulting from the calculation by the difference calculating means at a

time of switching when the output level of the drive signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

5 6. The switching power supply controller according to Claim 4, wherein the drive signal generating means switches a level of the drive signal from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal, and

10 wherein, based on the signal resulting from the calculation by the difference calculating means at a time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

15 7. The switching power supply controller according to Claim 1, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal

resulting from the calculation by the difference calculating means, and the ramp signal.

8. A switching power supply comprising the switching power supply controller as set forth in Claim 1.

9. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching power supply, the switching power supply controller comprising:

operation means for performing an operation on a signal corresponding to a duty ratio of the drive signal, the operation means integrally having a high-pass filter function and an integrating function;

difference calculating means for calculating a difference between a signal indicating a difference between an output voltage of the switching power supply and a target voltage for the output voltage, and a signal resulting from the operation by the operation means; and

drive signal generating means for generating the drive signal on the basis of a signal resulting from the calculation by the difference calculating means, and a ramp signal.

10. The switching power supply controller according to Claim 9, wherein the operation means is

configured based on a transfer function $H(Z)$ of the operation means as defined below:

$$H(Z) = 1/(1-b*Z^{-1}) \quad (b \text{ is a coefficient}).$$

11. The switching power supply controller according to Claim 9, wherein the operation means is configured based on a transfer function $H(Z)$ of the operation means as defined below:

$$H(Z) = (1-Z^{-1})/[(1-b_1*Z^{-1})(1-b_2*Z^{-1})] \quad (b_1 \text{ and } b_2 \text{ are coefficients}).$$

12. The switching power supply controller according to Claim 9, further comprising counter means for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a value resulting from the counting by the counter means.

13. The switching power supply controller according to Claim 9, further comprising delay means for retaining the signal resulting from the calculation by the difference calculating means, for a predetermined time and then outputting the signal,

wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by the delay means.

14. The switching power supply controller

according to Claim 13, wherein the drive signal generating means switches a level of the drive signal from a low level to a high level at a predetermined interval and switches the level of the drive signal from the high level to the low level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal, and

wherein, based on the signal resulting from the calculation by the difference calculating means at a time of switching when the output level of the drive signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

15. The switching power supply controller according to Claim 13, wherein the drive signal generating means switches a level of the drive signal from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal, and

wherein, based on the signal resulting from the calculation by the difference calculating means at a

time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

16. The switching power supply controller according to Claim 9, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal.

17. A switching power supply comprising the switching power supply controller as set forth in Claim 9.

18. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching power supply, the switching power supply controller comprising:

a first high-pass filter for cutting off a low-frequency component included in a signal corresponding to a duty ratio of the drive signal;

integrating means for integrating a signal resulting from the cutoff of the low-frequency component by the first high-pass filter;

a second high-pass filter for cutting off a low-frequency component included in a signal resulting from the integration by the integrating means;

5 difference calculating means for calculating a difference between a signal indicating a difference between an output voltage of the switching power supply and a target voltage for the output voltage, and a signal resulting from the cutoff of the low-frequency component by the second high-pass filter; and

10 drive signal generating means for generating the drive signal on the basis of a signal resulting from the calculation by the difference calculating means, and a ramp signal.

15 19. The switching power supply controller according to Claim 18, wherein the first high-pass filter and the second high-pass filter are first-order high-pass filters.

20 20. The switching power supply controller according to Claim 18, further comprising counter means for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

25 wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a value resulting from the counting by the counter means.

21. The switching power supply controller

according to Claim 18, further comprising delay means for retaining the signal resulting from the calculation by the difference calculating means, for a predetermined time and then outputting the signal,

5 wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by the delay means.

22. The switching power supply controller according to Claim 21, wherein the drive signal
10 generating means switches a level of the drive signal from a low level to a high level at a predetermined interval and switches the level of the drive signal from the high level to the low level on the basis of a result of a comparison between the signal resulting
15 from the calculation by the difference calculating means, and the ramp signal, and

 wherein, based on the signal resulting from the calculation by the difference calculating means at a time of switching when the output level of the drive
20 signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

23. The switching power supply controller
25 according to Claim 21, wherein the drive signal generating means switches a level of the drive signal

from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal, and

wherein, based on the signal resulting from the calculation by the difference calculating means at a time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means detects a value corresponding to the signal resulting from the calculation and outputs the detected value until a next time of the switching.

24. The switching power supply controller according to Claim 18, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal resulting from the calculation by the difference calculating means, and the ramp signal.

25. A switching power supply comprising the switching power supply controller as set forth in Claim 18.

26. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching

power supply, the switching power supply controller comprising:

5 a high-pass filter for cutting off a low-frequency component included in a signal corresponding to a duty ratio of the drive signal;

integrating means for integrating a signal resulting from the cutoff of the low-frequency component by the high-pass filter;

10 averaging means for obtaining an average of said duty ratio on the basis of the signal corresponding to the duty ratio of the drive signal;

15 gain adjustment value calculating means for calculating a gain adjustment value on the basis of a signal corresponding to the average duty ratio obtained by the averaging means, and a signal indication a target voltage for an output voltage in the switching power supply;

20 multiplying means for multiplying a signal indicating a difference between the output voltage of the switching power supply and the target voltage, by the gain adjustment value calculated by the gain adjustment value calculating means;

25 adding means for adding up a signal resulting from the multiplication by the multiplying means, the signal corresponding to the average duty ratio obtained by the averaging means, and a signal resulting from the

integration by the integrating means; and

drive signal generating means for generating the drive signal on the basis of a signal resulting from the addition by the adding means, and a ramp signal.

5 27. The switching power supply controller according to Claim 26, wherein the high-pass filter is a second-order high-pass filter.

 28. The switching power supply controller according to Claim 26, further comprising counter means
10 for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

 wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a
15 value resulting from the counting by the counter means.

 29. The switching power supply controller according to Claim 26, further comprising delay means
 for retaining the signal resulting from the addition by the adding means, for a predetermined time and then
20 outputting the signal,

 wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by the delay means.

 30. The switching power supply controller
25 according to Claim 29, wherein the drive signal generating means switches a level of the drive signal

from a low level to a high level at a predetermined interval and switches the level of the drive signal from the high level to the low level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the addition and outputs the detected value until a next time of the switching.

31. The switching power supply controller according to Claim 29, wherein the drive signal generating means switches a level of the drive signal from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means

detects a value corresponding to the signal resulting from the addition and outputs the detected value until a next time of the switching.

5 32. The switching power supply controller according to Claim 26, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and
10 the ramp signal.

 33. The switching power supply controller according to Claim 26, wherein the averaging means is a low-pass filter.

15 34. A switching power supply comprising the switching power supply controller as set forth in Claim 26.

 35. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching
20 power supply, the switching power supply controller comprising:

 operation means for performing an operation on a signal corresponding to a duty ratio of the drive signal, the operation means integrally having a high-
25 pass filter function and an integrating function;

 averaging means for obtaining an average of the

duty ratio on the basis of the signal corresponding to the duty ratio of the drive signal;

gain adjustment value calculating means for calculating a gain adjustment value on the basis of a signal corresponding to the average duty ratio obtained by the averaging means, and a signal indicating a target voltage for an output voltage in the switching power supply;

10 multiplying means for multiplying a signal indicating a difference between the output voltage of the switching power supply and the target voltage, by the gain adjustment value calculated by the gain adjustment value calculating means;

15 adding means for adding up a signal resulting from the multiplication by the multiplying means, the signal corresponding to the average duty ratio obtained by the averaging means, and a signal resulting from the operation by the operation means; and

20 drive signal generating means for generating the drive signal on the basis of a signal resulting from the addition by the adding means, and a ramp signal.

36. The switching power supply controller according to Claim 35, wherein the operation means is configured based on a transfer function $H(Z)$ of the operation means as defined below:

$$H(Z) = 1/(1-b*Z^{-1}) \quad (b \text{ is a coefficient}).$$

37. The switching power supply controller according to Claim 35, wherein the operation means is configured based on a transfer function $H(Z)$ of the operation means as defined below:

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$$H(Z) = (1-Z^{-1}) / [(1-b1*Z^{-1})(1-b2*Z^{-1})] \quad (b1 \text{ and } b2 \text{ are coefficients}).$$

38. The switching power supply controller according to Claim 35, further comprising counter means for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

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wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a value resulting from the counting by the counter means.

15 39. The switching power supply controller according to Claim 35, further comprising delay means for retaining the signal resulting from the addition by the adding means, for a predetermined time and then outputting the signal,

20 wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by the delay means.

40. The switching power supply controller according to Claim 39, wherein the drive signal generating means switches a level of the drive signal from a low level to a high level at a predetermined

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interval and switches the level of the drive signal from the high level to the low level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the addition and outputs the detected value until a next time of the switching.

41. The switching power supply controller according to Claim 39, wherein the drive signal generating means switches a level of the drive signal from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means detects a value corresponding to the signal resulting

from the addition and outputs the detected value until a next time of the switching.

42. The switching power supply controller according to Claim 35, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal.

43. The switching power supply controller according to Claim 35, wherein the averaging means is a low-pass filter.

44. A switching power supply comprising the switching power supply controller as set forth in Claim 35.

45. A switching power supply controller for outputting a drive signal for controlling a switching element of a switching power supply, to the switching power supply, the switching power supply controller comprising:

a first high-pass filter for cutting off a low-frequency component included in a signal corresponding to a duty ratio of the drive signal;

integrating means for integrating a signal resulting from the cutoff of the low-frequency component by the first high-pass filter;

a second high-pass filter for cutting off a low-frequency component included in a signal resulting from the integration by the integrating means;

5 averaging means for obtaining an average of said duty ratio on the basis of the signal corresponding to the duty ratio of the drive signal;

gain adjustment value calculating means for calculating a gain adjustment value on the basis of a signal corresponding to the average duty ratio obtained by the averaging means, and a signal indicating a target voltage for an output voltage in the switching power supply;

15 multiplying means for multiplying a signal indicating a difference between the output voltage of the switching power supply and the target voltage, by the gain adjustment value calculated by the gain adjustment value calculating means;

20 adding means for adding up a signal resulting from the multiplication by the multiplying means, the signal corresponding to the average duty ratio obtained by the averaging means, and a signal resulting from the cutoff of the low-frequency component by the second high-pass filter; and

25 drive signal generating means for generating the drive signal on the basis of a signal resulting from the addition by the adding means, and a ramp signal.

46. The switching power supply controller according to Claim 45, wherein the first high-pass filter and the second high-pass filter are first-order high-pass filters.

5 47. The switching power supply controller according to Claim 45, further comprising counter means for counting an on time of the drive signal generated by the drive signal generating means, every switching period,

10 wherein the signal corresponding to the duty ratio of the drive signal is a signal indicating a value resulting from the counting by the counter means.

48. The switching power supply controller according to Claim 45, further comprising delay means
15 for retaining the signal resulting from the addition by the adding means, for a predetermined time and then outputting the signal,

 wherein the signal corresponding to the duty ratio of the drive signal is the signal outputted by
20 the delay means.

49. The switching power supply controller according to Claim 48, wherein the drive signal generating means switches a level of the drive signal from a low level to a high level at a predetermined
25 interval and switches the level of the drive signal from the high level to the low level on the basis of a

result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the high level to the low level, the delay means detects a value corresponding to the signal resulting from the addition and outputs the detected value until a next time of the switching.

50. The switching power supply controller according to Claim 48, wherein the drive signal generating means switches a level of the drive signal from a high level to a low level at a predetermined interval and switches the level of the drive signal from the low level to the high level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal, and

wherein, based on the signal resulting from the addition by the adding means at a time of switching when the output level of the drive signal is switched from the low level to the high level, the delay means detects a value corresponding to the signal resulting from the addition and outputs the detected value until a next time of the switching.

51. The switching power supply controller according to Claim 45, wherein the drive signal generating means switches an output level of the drive signal to a high level or to a low level on the basis of a result of a comparison between the signal resulting from the addition by the adding means, and the ramp signal.

52. The switching power supply controller according to Claim 45, wherein the averaging means is a low-pass filter.

53. A switching power supply comprising the switching power supply controller as set forth in Claim 45.